SCALING TEVATRON I ANTIPROTON FLUXES FOR APPLICATION TO THE SSC

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Introduction

A $\overline{p}$ for the SSC $\overline{p}p$ collider should accumulate at least 10^9 $\overline{p}$/second to satisfy the minimum luminosity requirement of $10^{32} cm^{-2} s^{-1}$. Although the limit on a $\overline{p}$ source is most probably given by the rate of accumulation, here we extrapolate only the calculations for the antiproton production and collection rates performed for the Tevatron I project.[1]

Results of these calculations have been recently compared with actual yield measurements versus acceptance at the CERN AA ring.[2] Agreement to within 15% has been obtained. We assume that production of 10 GeV/c antiprotons from 150 GeV/c protons into a momentumn acceptance, $\Delta p/p$, of 6% and a transverse acceptance of $40\pi \times 10^{-6}$m is required for the SSC.

Expected $\bar{p}$ Fluxes at Production

From reference 1, figure 19, we obtain two values of $\bar{p}$ yield for 40π acceptance. For existing technology (Case A) we assume a lithium lens 1 cm in radius and 1000 T/m with a beam r.m.s size of 0.038 cm. For future technology (Case B) we will assume a lithium lens 2 cm in radius, 1000T/m and a beam r.m.s. size of 0.022 cm.

Antiproton yields vary approximately linearly with $\bar{p}$ momentum and proton momentum. Consequently we scale the yields upwards from 8.89 to 10 GeV/c for $\bar{p}$ momentum and from 120 to 150 GeV/c for proton momentum.

Experience at the CERN AA indicates that larger proton fluxes can be targeted than those assumed in the Tevatron 1 design (Reference 1). For copper targets the factor is at least 1.5 and this has been applied to Case A. Realization of Case B will require development of targets capable of withstanding three times more beam current density.

Due to the short focal length of the lithium lens, the use of copper necessitates some focussing within the target. Calculations and recent measurements at CERN show that an additional factor of 1.3 to 1.5 may be obtained from the conducting target technique.

The results of these extrapolation are summarized in Table I.

Conclusions

Antiproton fluxes of the order of 1.4×10^9 per second (into $40\pi \times 10^{-6}$m horizontal and vertical acceptances) and 6% $\Delta p/p$ seems quite achievable within small extrapolation of the calculations for Tevatron I. The only difficult technical assumption here is that a lithium lens similar to the Fermilab design could be pulsed once a second, or twice the present design repetition rate. If this presentes insurmountable problems, beam switching between two or more target/lens assemblies operating at reduced pulse rates could be envisaged.

TABLE I

(All for 40π mm mrad Vertical and Horizontal Acceptances)

	Case A	Case B
$\bar{p}$ yield (per incident proton per GeV/c)	2.8×10^{-4}	4.2×10^{-4}
$\bar{p}$ yield (8.89 GeV/c → 10 GeV/c)	3.2×10^{-4}	4.7×10^{-4}
$\bar{p}$ yield (120 GeV/c → 150 GeV/c)	3.9×10^{-4}	5.9×10^{-4}
$\bar{p}$ yield (per incident proton per 6% Δp/p)	2.4×10^{-4}	3.6×10^{-4}
Maximum number of protons on W target[1] (per second)	3.0×10^{12}	3.0×10^{12}
$\bar{p}$ per second	7.1×10^{8}	1.1×10^{9}
Conducting copper target (x 1.5 x 1.3) ($\bar{p}$ per second into 40π and 6% $\frac{\Delta p}{p}$)	1.4×10^{9}	2.1×10^{9}

1) Carlos Hojvat and A. Van Ginneken, Nucl. Inst. Meth. 206 (1983) 67.
2) C. Johnson and C. Hojvat, in preparation.